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ATTACKING ACCIDENTS AT THEIR SOURCE—PAGE THREE

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COVER STORY

You will never see the scene shown on this issue's cover. It is an architect's conception, prepared by the firm of Skidmore, Owings & Merrill, of how the new Air Force Academy at Colorado Springs was to look. Among other considerations, members of Congress objected to the use of so much glass. The Chapel, which received a great amount of comment, is shown at the upper left of the picture.

—Official U. S. Air Force Photo

At their Source:

Attacking Accidents

By John D. Gallagher

It is still common to encounter the viewpoint on the part of some managements and supervisors that industrial accident prevention is an activity entirely separate and apart from the day-to-day problem of getting out production. Of course this fallacy has long since been disproved by carefully made studies, which show that there is a positive correlation between safety and efficiency of production, and that, in general, the safe factory is the efficient factory.

The reason for this is that the same causes in industrial operations which result in employee injuries are also responsible for damage to materials and equipment, and for other hindrances to efficient production. It is our intention here to discuss the basic sources of conditions causing employee injuries and related operating inefficiencies, and to indicate how these sources may be better controlled in order to eliminate or minimize these undesirable results.

The industrial supervisor, of course, is the principal key figure through whom should be accomplished the smooth and efficient functioning of all production facilities, so that optimum production results will be achieved by making the most efficient use of the equipment, facilities, and personnel under his control. Any weakness in his control over basic production facilities may result in production hindrances; by which we mean anything that interferes with the orderly progress of the production job, or with getting it done on time, or in the correct way. A few examples of such hindrances are:

Production delays, damaged equipment, reduced rate of production, etc.; scrap and re-work, employee injuries, unnecessary material handling, excess man-hours per unit of production, excess machine-hours per unit of production, poor employee morale, high labor turnover, and so on.

Such hindrances result from accidents, if we use the term "accident" to mean "any unexpected event that interrupts or interferes with the orderly progress of the production activity or process." In this sense of the word we can have an accident involving a mishap that may cause damage to equipment or materials, a production delay, and so on, without necessarily involving an injury as a result. Whether or not an injury would result from the mishap is usually a matter of mere chance, even though we may have interference with the smooth flow of production as a definite result.

For example, an explosion occurred in a duct through which a flammable dust was being exhausted. The duct was violently blown apart, and a fire resulted, causing damage to production facilities. The location where the duct was violently blown apart immediately adjoined a work position. By mere chance the explosion occurred at a time when the people were away from their work, and had the explosion occurred a half hour earlier or later than it did, there would undoubtedly have been at least a half dozen very serious injuries. Although this incident, by chance, did not result in employee injuries, it was still an accident in the sense that it resulted in hindrances to smooth and efficient production.

It is generally recognized that practically all of the facilities essential for industrial production can be classified in one of three categories, that is, either as Equipment, as Material, or as People. It is obvious that these three production factors must be managed and controlled efficiently if production hindrances are to be avoided, and we are to achieve injury-free and optimum efficiency of production. Optimum results can be achieved only when adequate consideration is given to the following production factors with respect to Equipment, Materials, and People:

Equipment	Material	People
Selection	Selection	Selection
Arrangement	Placing	Placing
Use	Handling	Instructing
Maintenance	Processing	Supervising

Equipment

Equipment represents an investment that will produce the greatest production-wise return only when proper consideration is given to its selection, arrangement, use, and maintenance.

It must be selected and designed to handle the work adequately and most effectively, with a minimum amount of non-productive effort. If the machine selected for a given job is too light to handle the work properly, the result may be a reduced rate of production; spoilage of material; possible break-down, or damage to the machine; and the possibility of employee injuries.

If equipment is not arranged for smooth and efficient production flow, the result will be unnecessary material handlings, transportations, and back-tracking, with a definite increase in operating costs and exposure to injuries. Material handling is the source of approximately 25% of all industrial injuries, and is also an important labor cost factor; and all of the other production hindrances referred to also, of course, add up to higher dollar operating costs.

If equipment is not properly used for the purpose contemplated, and so that it performs in the manner intended, the result may be a reduced rate of production, spoilage of material, injuries, possible break-down or damage to the machine, and so on.

Equipment must be properly maintained, so that it will give a maximum amount of service, with a minimum of repair-time and lost time through break-downs, and without unnecessary replacement expense. If proper maintenance is

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Mr. Gallagher, the author of this paper, is assistant superintendent, Engineering Department, Hartford Accident and Idemnity Company.

not given, the result may be break-downs and inadequate performance, which are often sources of injuries; as well as of possible production delays, reduced rate of production, spoiled materials, excess man-hours, excess machine-hours, etc.

Material

If material is not properly selected so it will be most effective for a particular operation it may stick in the dies, or other machines, or require other special attention which optimum selection would avoid. The results may be spoilage of materials; reduced rate of production, causing excess man-hours per unit of production, and excess machine-hours; injuries; and so on.

Material must be properly placed so it will be available at the right time and place to fit smoothly into production flow; will take up the least amount of space; will not interfere with operations; will not deteriorate because of exposure, or affect people in the plant because of their exposure to it; will not constitute a fire or explosion hazard: and so on. Failure to place materials properly may cause excess material handling, and other problems resulting in possible production delays, excess man-hours, excess machine-hours, injuries, and spoilage of materials.

If proper consideration is not given to the handling of material we are apt to have high handling costs, delays, damage to materials and equipment, injuries, etc. In order to avoid these results it is necessary to consider whether materials will be most effectively handled by conveyor, by hand, by trucks, or exactly what is the most efficient way to handle them according to their characteristics, and according to production requirements.

If inadequate attention is given to the proper processing of material, similar difficulties may ensue. On metal working operations we may run into trouble if we don't use the right coolant, or the right drawing compound. In some operations materials must be processed at certain critical temperatures, or under other controlled conditions; and inadequate consideration to processing requirements may result in production delays, reduced rate of production, spoilage of material, injuries, excess man-hours, excess machine-hours, and so on.

People

People in an organization represent an investment, as considerable time and money are spent in their employment and training. This expenditure will pay dividends only if proper consideration is given to their selection, placing, instruction, and supervision.

Selection is particularly important because every job requires a worker with certain characteristics, experience, physical capabilities, skills and aptitudes, and every individual varies; so that it is important to select people who have the desired combination of characteristics. Failure to select workers according to the specifications required for the job may result in excess man-hours, reduced rate of production, spoilage of materials, damage to equipment, injuries, high labor turnover, and so on.

People must be properly placed in a

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Sabotage Without Intent

By Benjamin F. Gerding, Jr.

The human touch which guides every engineering project towards technological success also seems to undermine the very effort that is being made, to the extent that most engineering endeavors end up with something less than complete success, and not too infrequently, as failures from the operational point of view. This undertow is, to borrow a phrase from L. Jacobson, chief engineer of the Philadelphia Plant of the International Resistance Company, a sort of "sabotage without intent," and as such severly restricts the effectiveness of the engineering program.

Perhaps two examples of this action will serve to clarify this human failure in engineering applications.

Recently the foreman of the plating department of a local company (a very conscientious and technically-capable man) was supervising the introduction of a new plating process into production. The installation had not been completed, but some work was being processed. A large vertical tank was delivered to his department. The tank was 4 feet wide, 3 feet deep, 7 feet high, open on the top, with a drain valve on the bottom. The next day maintenance workers positioned the tank on a two foot wooden platform, and, when questioned, told the foreman that the device was a new "mixing tank."

The foreman regarded his new acquisition with increasing concern and wrath. The open top was now 9 feet from the floor. He visualized his men climbing ladders with active chemicals, the drain seemed designed for a bucket, and there was simply no way to insert mechanical mixing vanes. Obviously the tank had been designed by an engineering numbskull with no conception of the operational problems concerned in mixing plating baths. Faced with an impossible situation, he called the plant superintendent to report the latest engineering snafu.

Mr. Gerding, senior manufacturing engineer, International Resistance Company, Philadelphia, presented this talk before the Eastern Seaboard Conference of the Society of Women Engineers on March 19, 1955.

The plant superintendent raised the roof with the maintenance foreman (for the wooden stand) and made a somewhat emotional report to the works manager, who, used to this sort of thing, called his chief engineer.

After investigation, the chief engineer was able to report that the installation was incomplete, that a horizontal mixing tank was yet to be delivered, and that a chemical pump and piping would transfer the mixed bath to the already installed vertical storage tank. The drain was to be connected to the operating tank. So viewed, the design was, in truth, an engineering triumph; a convenient, semi-automatic installation that any foreman should appreciate.

So, the explanations were made, but somehow the project had been undermined—somehow the glitter of a well-engineered job had been tarnished. In the minds of the production people there lingered some thoughts that the engineers had once again managed to slip out from under a poor job.

The failure was a human one. The design engineer had not consulted with the foreman, so that at least he would know what equipment to expect, and how to handle it. This was a typical example of "sabotage without intent" which, fortunately, did not end in a much more typical lasting state of confusion.

The ledger has two columns. In another instance, draft shields were attached to a process oven, and had to be manipulated by the operators. Unless adjusted properly, the shields affected product preformance, but unfortunately the design was awkward and misadjustment was the rule. The history of the device included an attempt to improve the shielding action by a redesign which, however, was even more difficult to adjust and had been rejected by the operators ("sabotage . . . ?).

A new approach to the problem was tried when it became imperative to shield the oven for performance reasons. The foreman was approached by the engineer with a prototype shield, and his help was requested. Due to his knowledge of the social structures of his department, he was able to select the operator who was the unofficial "leader" of the majority grouping of the employees (sometimes—not always—this "leader" is the shop steward).

The prototype shield was shown to this operator, and suggestions were encouraged. Although, technically speaking, the suggestions offered did not improve the device, neither did they adversely affect the performance, and so were adapted in the final design. The subsequent installation was well, even enthusiastically received, with operators contesting among themselves for the privilege of an early machine modification.

The moral, if any, in these two accounts is that the human angles, properly evaluated and used, can make the technical effort completely effective, while the consequences of neglecting this consideration may cause complete failure, and at least will impose restrictions or limits on the effectiveness of the engineering effort. The human elements simply must be integrated into the technological planning.

By definition, engineering in general deals with the application of the basic sciences to social use, and since the history of engineering effort is studded with this type of human failure, it is becoming increasingly important that the problems be analyzed and that appropriate action be taken to minimize the restrictive effects. As such, this study forms a part of the wider and more complex problem of the general impact of our racing technology upon our social structures and, more specifically, upon the individual industrial workers.

To whom shall we turn for help? It would seem only fitting that those people who have made a career of studying the interactions between humans should be called up on to furnish the leadership in the solution of this typical human problem. A review of the literature is impressive. People have been studying

and writing about other people since the beginning of written communications. The ancients supply the Bible, a series of documents whose ethics, morality, and other human values form the foundation for the entire social behavior of Western civilization. The Greeks and others provide human-relations studies that, strangely enough, parallel a great deal of modern thought.

Currently we are deluged with novels, plays, social-study publications, out pourings from psychologists, sociologists, anthropologists, etc., all dealing essentially with the relations between people. Certainly T. S. Eliot, Hemingway, Steinbeck, or Dr. Norman Vincent Peale should be of direct aid to us in our problems. Along with the social scientists, these are the groups who study people, develop the theories, collect clinical data, and these are the people who logically should guide us.

As we view the vastness of the knowledge of human behavior and relationships so tantalizingly available, your writer, as a practicing engineer, is most humble. In a sense, it is somewhat ridiculous for an engineer to write for other engineers on a subject which is at once so important to engineering, and yet which is so essentially foreign to his technical training. It is almost a case of the blind attempting to lead the blind. Yet, as individual engineers, we have to deal daily with "Helen" and "Joe" and "Harry," who are real people in real, always complex, human situations—and we have to make out, somehow. We cannot operate with a psychologist at our elbow, we cannot theorize, we cannot design and interpret social experiments, nor can we organize whatever actual experiences we have into neatly packaged procedures and policies. Let's face it! We do need help, and the people who should be able to help us directly seem far away indeed.

One gets a feeling of helplessness too, as one surveys the history of the dynamically developing relationhsip between our accelerating technology and our industrial social orders. We can hear the groanings and creakings of the social structures as they strive to cover the ever-changing framework of our technology. From the start of the Industrial Revolution, each technical advance has been associated with social change — the growth and evolution of the Union movement, for instance, has given dramatic emphasis to this continuing adjustment. As this is written, another step is planned in which some sort of guaranteed annual wage system will be proposed, ostensibly to cover the development of industrial automation, the latest technical arrival on the industrial scene. So the stretching goes on, and both past and future seem to whirl with the movements of massive forces which

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Zilch · Zumas / gerf = Something

Youngsters who once had trouble adding "one, two, three" are adding "Zilch, Zumas, gerf," and doing logarithms with interest and understanding in a new approach to high school mathematics which has been developed at the University of Illinois.

They are getting a better understanding of the whole business of math and its use, avoiding the old walls between arithmetic, geometry, algebra, and trigonometry, and are expected to learn as much in three years as their classmates in conventional four year courses.

The program has attracted nationwide attention. It now is being tried in a dozen classes in five schools, with 15 more schools planning to adopt it next fall. Now using the plan are University High School in Urbana, and high schools in Barrington, Blue Island, and Pekin, Ill., and Dearborn, Mich.

The idea is a joint development of three University of Illinois units, the College of Education, College of Engineering, and College of Liberal Arts and Sciences math department. It grew from a committee formed in 1951 to help high schools meet increasing math requirements of engineering colleges.

Eugene D. Nichols, committee chairman and teacher in University High School, says, "The program has been designed to interest more high school students in math, to teach them more of the important ideas of math, and to give them a broad understanding of math principles rather than just manipulative skills."

In other words, students don't just memorize what to do, but understand why, and so they get interested.

Take for instance, the "zilch, zumis, gerf" business. That's not junior talking with a mouthful of breakfast cereal, nor a new cheer for the basketball team. It's serious math. The idea is that "one, two, three," by any other names stand for the same numbers — or as one Shakespeare-minded individual said, "a number by any other name is still a number."

These are words thought up for numbers. Students learn that addition or multiplication is just as possible with these new terms as with those more conventional. He understands that the concept is important — not what we call it. Few high school students ever understood this before — the idea usually is presented in college, and peculiarly, also first grade.

This is the sort of "why" the new program presents. It emphasizes understanding rather than the isolated facts of traditional courses. It shows the relation of algebra, geometry, and the like, and this permits teaching more math in the same amount of class time.

For the two out of three students who never go beyond one year of high school math, the program presents a lot of useful information — far more useful than the traditional first-year algebra course — and at the same time is a better foundation for those studying more than one year.

It acquaints a student with math — algebra, geometry, and trigonometry — making it possible for him to choose more intelligently whether he wishes to go into a life work, such as engineering, in which math is important.

He learns too that math is not a dead subject about which everything is known. The program is stimulating to the talented student, at the same time highly valuable to the less talented because of its emphasis on understanding.

Integrating the teaching of high school math to do away with the artificial subject barriers has been talked about for a half-century, but this is the first time a real attempt has been made to do something away from the traditional routine. Completely new teaching materials are being developed. A lot of repetition and deadwood has been dropped out.

The group known as the University of Illinois Committee on Secondary School Mathematics includes Nichols and two other University High School math teachers, David A. Page and Charles R. Stegmeir, also Prof. Daniel S. Babb of the College of Engineering, Prof. Robert E. Pingry of the College of Education, and Prof. Gerhard P. Hochschild of the University's mathematics department.

The new teaching program was started two years ago. In 1956 when the third year is completed, students will be tested against others who have had four years of conventional high school mathematics.

Problems solved by the students are right into the aviation and electronic age. Even the "thinking" of electronic brains—devices such as the University of Illinois "Illiac" which can multiply a pair of 13-digit figures by each other

1,000 times in a second — are no secret to these high school mathematicians. The computer works with a binary number system — its electric charges are either plus or minus — and the students work out problems in this system too.

Engineers Receive Agricultural Award

To honor outstanding engineering achievement in the field of agriculture, the American Society of Agricultural Engineers, on the occasion of its annual dinner held in Urbana, Ill. on June 14 at the Illini Union on the campus of the University of Illinois, awarded the John Deere Gold Medal to Walter W. Weir, Berkeley, California, and the Cyrus Hall McCormick Gold Medal to Robert P. Messenger, Chicago. These medalists were selected by a jury of awards consisting of the seven immediate past-presidents of the society, and the medals were formally presented to the recipients by ASAE president George B. Nutt of Clemson, S. C.

General MacArthur Writes WSE

Dear President Sullivan:

I cannot tell you how deeply moved I am by the action of the Board of Directors of the Western Society of Engineers in conferring upon me Honorary Membership in your distinguished Society. I started my military career as an engineer and since laying down the mantle of public responsibility have rejoined that mighty fraternity through affiliation with a company dedicated to mastering the secrets of electronic science; and it is my earnest hope that throughout the intervening years I may be credited with having lived according to the engineer's code.

Engineering, above all other professions, contributes toward the betterment of human life by providing practical application to progressive scientific knowledge—the means whereby the creative imagination of the scientist is put to practical use—and by devising mechanical processes expedites the requirements of everyday life. Thus, he who tills the soil to produce the food we eat must look to the engineer to devise the means of irrigation, of mass production and of wide distribution; he who weaves the yarn to produce the clothes we wear must look to the engineer to devise the mechanics whereby may be met the mass needs of our expanding population; and he who builds the homes in which we live must look to the engineer to provide essential aids to human labor.

In all things which have paved the way for human progress—mining, manufacture, transportation—the engineer has pointed the way. While in war his talents were temporarily diverted toward destruction, he was inevitably called upon to rebuild—sometimes in the heat of battle when the swirling tides of fortune turned, then in war's desolate aftermath with the dawn of renewed opportunity for peace. From the Pyramids of ancient Egypt to the great bridges which span the waterways of the modern world the engineer has truly

worked miracles which dot the earth with monuments to his constructive efforts in the service of mankind.

I am glad, indeed, midst the deepening shadows of life, to have my name enrolled among so many distinguished engineers upon whom rest so heavily civilization's further progress.

While deeply regretful that I will be unable to be with you in person at your annual meeting next month, I do want you to know how very grateful I am and send you all my cordial and fraternal greetings.

Faithfully yours,
(signed) Douglas MacArthur

A Company with Pep

A Florida electric company recently issued its 15 millionth vitamin tablet to an employee, *Electrical World* reports. Started in 1946 as a part of the company's health and safety program, the free distribution of vitamins and cold tablets began after a marked vitamin B deficiency was noted in 85 per cent of employees tested by a Miami physician over a period of years.

Accreditation Sought For In-Plant Courses

Reputable in-plant training courses should be accreditable toward advanced degrees in engineering or science, the American Society for Engineering Education was told at University Park, Pa., on June 23.

The view was expressed in a paper by Robert C. Kintner, professor of chemical engineering at Illinois Institute of Technology, Chicago, at the society's annual meeting at Pennsylvania State University.

Kintner admitted that in-plant courses given by industrial organizations sometimes do not meet the high academic standards established by graduate schools.

"Once such standards of quality are met, however," he asserted, "there is no reason to penalize an employe (who is working toward an advanced degree) because he took a company course. He should not be made to repeat the course in a college classroom and be bored with the procedure."

Kintner said that most graduate schools do not permit, or limit, the transfer of credits from other universities and colleges. Illinois Tech, like most other accredited institutions, accepts the transfer of only a small amount.

"After satisfying ourselves that a company-given course is of high caliber, is given by a competent teacher, and is a valid part of a degree program existing on the campus, we see no reason to differentiate between such a course and one given at a distant college," he said.

Kintner described IIT's procedure in handling in-plant courses of the Commonwealth Edison company, Chicago, some of which nearly duplicate courses given in the Illinois Tech electrical engineering department.

"Our electrical engineering department has found that a satisfactory performance in the examinations given by the Commonwealth Edison instructor is a sufficient criterion to establish credit," he said.

Kintner's paper was read by Stanton E. Winston, dean of the evening division at Illinois Tech.


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Attacking Accidents

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job according to their experience, skill, and their mental and physical traits, so that the job and the individual are properly matched, in accordance with the demands of the job and the characteristics of the individual. Failure to do this may result in the production hindrances previously mentioned, including poor employee morale, high labor turnover, and injuries.

Workers must obviously be well instructed in the job they are to do, so that they will understand what they are doing and why they are doing it, and in order to do their work safely and correctly. Failure to carry out good job instruction may not only result in employee injuries, but also in most of the other production hindrances already referred to.

For the efficient operation of any business it is necessary to control the essential facilities of production effectively through proper supervision; and this is especially important with people, in order that they will consistently do a good job. In this connection, it is important to remember the old expression that one of the essential needs of a good supervisor is that he must understand how to apply the principles of constructive leadership, so that he will supervise by leading his people instead of by driving them. General Patton is said to have remarked: "In a sense, a man is like a piece of cooked spaghetti, in that if you get behind him and try to drive or push him, you don't get very far. But if you get around in front and lead him he'll usually follow along in the way you want him to go." Leading his people means that the supervisor usually gets them to do what he wants done, when it should be done, and in the way he wants it done; because the good relations he fosters with his people make them want to do the job his way. Thus, by applying constructive principles of leadership in his day-to-day supervision he will usually have a more cooperative work force, than if he fails to do so. Failure to supervise constructively often results in a non-cooperative or indifferent employee attitude; which may result in a reduced rate of production, excess man-hours, excess machine-hours, spoilage of material, injuries, damage to equipment, damage to material, poor employee morale, and high labor turnover.

Supervisory Skills

It is generally recognized that, as a minimum, every industrial supervisor should have: knowledge of the work he is responsible for; knowledge of his supervisory responsibilities; skill in instruction; skill in planning his work; and skill in leadership.

It is obvious that in order to do a good job, the supervisor must have an understanding of the operations and processes, the equipment and materials, etc., that are necessary to accomplish the work he is responsible for.

It is also obvious that he must have a knowledge of his own company situation. That is, he must be familiar with inter-departmental relationships; company rules and policies; he must be familiar with various agreements, such as the Union Contract, and so on; which all impose certain responsibilities upon him, and comprise the knowledge he must have of his supervisory responsibilities.

He must have skill in giving good job instruction, so that he can effectively pass on his knowledge of the various details of his jobs to those who will actually do the work; and so he will have a well-trained work force. Workers who are not well trained are apt to make mistakes, which may cause delays, injuries, damaged material and equipment, and the many other production hindrances already referred to.

Skill in planning his work enables the supervisor to make the most effective use of his materials, equipment, and people, by eliminating unnecessary elements in his jobs, and by combining, rearranging, and simplifying the details of his jobs; and it enables him to eliminate mistakes, wastes, and other problems that result from improperly placing, handling, and processing of materials, and from improper use and maintenance of equipment. Any weakness in the application of this skill may obviously result in injuries, and in the other production hindrances mentioned.

Skill in leadership is important because the supervisor gets his results by working through people; and to get good results, he must have good relations with them, and must foster a cooperative attitude on the part of his work force. Failure to develop and maintain a cooperative attitude on the part of his people may create an employee attitude of indifference towards their jobs, which often results in injuries, and the other production hindrances previously referred to.

Reaching the Accident Source

It is evident, therefore, that failure to give proper consideration to each of the 12 production factors relating to equipment, people, and materials, or weakness in applying to those factors the five supervisory skills and knowledges, may result in both injuries, and other hindrances to efficient production. That is, production hindrances and injuries both stem together from the same source, and that source is failure to properly apply any one of the production factors or skills. Therefore, proper investigation of injuries in many cases may enable us to get back to the weakness in applying the supervisory skills to one or more of the 12 production factors; and thereby to determine the basic source not only of the injury, but also of other production hindrances which may stem from this same weakness.

Therefore, to attack our accidents at their source, our accident investigation should be directed toward getting back to the basic weakness involved and correcting it; so that we may eliminate not only the source of the injury, but also the source of some of our other hindrances which interfere with efficient production.

Here the question may arise as to what action the safety engineer should take when the source of weaknesses resulting in injuries and other production hindrances has been determined. Space does not permit the full development of this subject, but a few of the possible corrective measures available may be briefly mentioned.

Such actions, when followed through, apply correction at the source, both for injuries and for hindrances to efficient production which stem from that same source. In this respect it should be recognized that although the safety engineer is a staff functionary, and does not have line authority, he should be able to discuss the conditions responsible with management, and with the supervisors involved. Also, that in selling his corrective suggestions he will be more successful if he can demonstrate to management that an injury is only one of many hindrances to efficient production that may result from weaknesses in the basic production factors and supervisory skills previously referred to.

If accident investigation or analysis discloses that the factors relating to the selection, arrangement, use, or maintenance of equipment, or the selection, placing, handling, or processing of materials are not receiving proper attention, it may be necessary for the safety engineer to consult with the plant engineering department, or the production superintendent.

If the weaknesses involved lie in the supervisor's use of, or assignment of job runs to machines; or in his placing,

handling, or processing of materials; satisfactory correction may require his being instructed in the use of better methods, and possibly in the principles of job methods improvement, so he will be more skilled in planning his work effectively. In some cases correction may lie in developing better job descriptions for the supervisor's guidance.

If inadequate equipment maintenance is involved, perhaps a better schedule for periodic maintenance of equipment should be drawn up for the maintenance department to follow; and arrangements made for them to keep more accurate records of maintenance work done. In such cases a copy of this schedule could also be provided to the supervisor involved, so he could plan his production to fit in with scheduled maintenance activities; and so he could see that such work is done on schedule, if the maintenance department should become lax in this regard. Copies of equipment maintenance schedules could also be provided to the safety engineer so he could check, when necessary, on proper application of maintenance.

If inherent job hazards are responsible, the safety engineer could cooperate with the methods engineer in making a study of the job method, so the hazard may be eliminated or better controlled by a job method improvement. If necessary, the safety engineer could make such a study himself, for this purpose.

If proper selection or placing of people are involved, it may be necessary to develop a better set of job specifications for use of the personnel department; and it may also be necessary to secure more effective attention of the supervisor to matching job specifications against the qualifications of personnel sent to him for acceptance and placement.

If inadequate job training is involved, correction can be achieved by educating supervisors in an effective technique of on-the-job instruction; in how to make job break-downs for use in instructing workers; and in maintaining a training time-table to insure that qualified replacements are always available for all jobs. Proper follow-up of supervisors to insure their consistent use of these techniques may also be advisable.

If negative employee attitudes are involved, the supervisor can be indoctrinated in the principles of job relations, so that he will be able to apply constructive principles of leadership in his day-to-day supervision; will be able to recognize incipient grievances in their early stages; will understand the various types and sources of grievances (conditions outside the job, conditions within the worker, conditions on the job, substitute grievances, imaginary grievances, etc.); will know how to counsel with his people and correct grievances in their early stages; will understand the technique of handling and adjusting bona fide job grievances; and so on. In this situation it may also be advisable to give consideration to job evaluation as a means of adjusting job inequities.

In accordance with the generally recognized fact that there is a definite relationship between safety and production efficiency, the foregoing consideration of the basic skills and production factors has indicated that wherever there is a weakness in their application, there may result both an injury and the other production hindrances indicated. Since the occurrence of an injury may be an indication of some weakness that can also cause other hindrances, the source of an injury is far more important than the immediate result, when an injury occurs. For best results consideration should be given to finding and eliminating the sources of injuries, not for the sake of injury prevention alone, but also for the sake of preventing all of the related hindrances to efficient production.

Sabotage

(Continued from Page 6)

we, as individuals, seem to control so little.

In this light, this paper may seem unimportant. But we still have to deal with "Helen" and "Joe." Regardless of the environment, there will still be engineers, and there will still be workers, and the problem of using both effectively will still be with us.

Let us look again at the ancients. If we should review their technology, we could, at best, evaluate it as primitive. Their literature on human understanding, however, has value today. This would suggest to us that our technical abilities are progressing faster in some way than our understanding of and ability to handle human relations. It would seem that if only we could apply our engineering techniques and knowledge to people, that we should get comparable improvements, and be able to develop and evaluate a kind of "human relations efficiency." That this has not been done over the years would indicate that the same techniques cannot be applied in both areas. Just why this should be so would seem to be an important factor in this investigation.

Roethlisberger, of the Harvard Business School, and probably the foremost interpreter of Western Electric's Hawthorne Experiment, gives us a clue. In his book, *Management and Morale*, he points out that in dealing with people, feelings and sentiments are all important, and that, sometimes disguised as facts, these sentiments are the prime human motivating factors.

This concept deserves a thorough examination: Stuart Chase, the well known economist and semanticist, in his book *Power of Words* tells of a man on a train who makes three comments on the progress of the train. First he notes, "This train is going 20 MPH." (a valid estimate, based on logical experience) then, "I will be late getting home." (an inference which more or less logically follows from statement number one) and finally "This is a helluva railroad!" (an expression of sentiment, that Chase calls a value judgment). This latter statement, presented as a fact, is, in truth, neither fact nor error, but a typically non-logical human expression of feeling.

Roethlisberger describes the man who makes the statement, "This room temperature is 72°." If anyone questions his judgment, appropriate instruments can prove that the statement is either truth or error. However, if the statement were modified to, "This room is too hot" and an argument followed, it would be a fruitless discussion. Fact or error do not characterize the statement which, although disguised or presented as a fact, is really a feeling or sentiment. It can be demonstrated that sentiments vary with age, sex, cultural background, nationality, time, place, etc. An old lady might think the room "chilly," while an Eskimo might find it "suffocating." (Note, too, that a logical presentation of scientific data that might prove the temperature to be "normal" would not change the expressed feeling that the room is "too hot" or "chilly.") Logic can never prevail against sentiment, and this is precisely where engineering treatments fail in human relations. We have all had experiences in which we have had a desire to do something and have not been allowed the opportunity, with the denial accompanied by good logical reasons why we should not do what we wanted. We may have been stopped, but left the discussion still feeling that we were right. In general, the application of straight logic in human relations has the non-logical consequence of producing frustration, insecurity, and exasperation.

All this just goes to indicate that human beings are social animals, and as such are seldom motivated by logic alone. In fact, man's (or woman's) favorite pastime is either to modify sentiment by logic (I need a new car because . . . and all the logic flows to support the statement) or rationalize sentiments (I can't go because . . . and the logic again rescues the feeling). This preoccupation with sentiment does not mean that people are motivated in an illogical manner. The logics of engineering are simply replaced by the non-logics of human behavior in which sentiments or

feelings are the strongest motivating force. To illustrate, there is only one logical reason for wearing a hat, that is to protect one's head. But when we tip our hats, when in one church hats are required, and in another prohibited, these actions and requirements are non-logical in nature. This same theme threads through almost all social contacts. Shaking hands with a friend, or wearing a necktie are non-logical actions. Where is the logic in attending or participating in a football game? In golf? In fact, in any sport? What is the logic behind women's clothing styles? What logic motivated Beethoven? Or indeed any of the artists in any of the arts? Religion relies on faith (a sentiment) rather than logic. Social group activities such as dancing, parades, etc. are non-logical. In fact, if we should strip all non-logical motivation from human activities, we would have left empty mechanical lives, with no joys or sorrows, no political or spiritual expression, no prefences or dislikes, no individuality. Life would not be worth living.

One important characteristic of non-logical behavior is that it tends to identify the individual with a group. This is a major factor in developing the social pressures that make it easier to get volunteers to risk their lives by going to war than it may be to get an employee to file an idea in the company suggestion box.

So human beings are social in nature, and respond to their environment emotionally. Logic is but a small force in their lives. This then is the problem. A non-logical set of values regulates people. This is different than the logic of technology which has been so successful with engineering materials and the scientific laws.

Management in general, and engineers in particular, make false assumptions as to worker motivation. A common error is the belief that economic gain is the prime factor. Rules set, actions taken, and decisions made with this as a premise frequently fail, for no apparent reason. Also, supervisors are often put squarely in the middle by the paradox derived from the logical procedures set by management, which the supervisors must enforce and the very human, non-logical behavior of the employees. In this respect, the effects of not appreciating the non-logical systems of human reactions go far beyond the engineering implications.

Probably it is now time to re-examine the question. Why do we have unintentional sabotage? Why is man himself an engineering problem? Strictly speaking, people cannot be an engineering problem, since they cannot be handled by engineering techniques. The problem is, then, how can the engineering effort be made compatible with the non-logical hopes, aspirations and fears of both the engineers and the workers?

Roethlisberger has some suggestions. In your contacts with your "Helens" and "Joes," listen patiently to their complaints and suggestions. Make a determined effort to understand what they are saying, and possibly more important, why they are saying it. Do not interrupt, instead help them to express themselves. Refrain from moral judgments. It is not your position to judge statements or actions; try to get at the reasons for them, as they may be more meaningful. Do not argue. Remember the fallacy of attempting to sway sentiments by logic. The worker doesn't want logic, he wants understanding. Do not make the mistake of listening only to the manifold content of what is said to you. Look behind it a bit—is the worker a new employee, not yet oriented? Or is he a well adjusted man, respected by his fellow workers? Is he in trouble personally?

To this we add the concept of participation. A successful engineering application cannot be conceived, executed, and terminated by the engineers alone. There are always other people brought into the picture, but not always early enough. As pointed out in the two examples given earlier, participation by others contributes to the engineering effort if timed correctly or detracts if participation is delayed. Participation there will certainly be, but possibly of an undermining nature.

There are few who know more detail of the job than the people who do it, and properly approached, these same people present a continuously amazing source of good information. Why let it

go to waste? Your writer is not ashamed to admit that some of the best suggestions on his engineering projects come from the operators, mechanics and inspectors on the job. This is a two-way street. Just as surely as participation aids the engineer, it aids the individual who is allowed to share in the project. There is, in fact, hardly any better way of securing cooperation, good work, and a cordial atmosphere than by going into partnership with the skills and knowledge of those with whom you are working.

About the only disadvantage associated with a sincere program of participation is the possibility that the engineer's pride may be injured as a non-logician presents a simple solution to a complicated technical problem. But then, professional humility is said to be a desirable attribute.

Does all this sound like too much trouble? Boiled down and distilled, the action is simply to put yourself in the other fellows shoes, then do what comes naturally. Unless you do this, says C. Cooling, methods engineer and author of *Front Line Cost Administration*, you cannot do justice to the human relations part of your engineering job, and you will be sabotaging your own efforts.

The question arises as to what the engineering schools are doing about all this. The word is going around, and the alert has been sounded. Realizing that their technical graduates are something less than well-rounded men, they are, in the words of K. Riddle, dean of the Drexel Evening College, "filling in the intellectual shrubbery" by offering cultural subjects along with the engineering curriculum. Some colleges are offering five year courses in which both B.S. and B.A. degrees are granted, and in which the basic technieal work is heavily supplemented by the humanities.

Thus we are come the full circle. The vast literature and knowledge available in the social sciences can now be added to the engineer's basic training, and be of some immediate help to him in the industrial situation.

Mr. Edwin Barker, educational secretary of the English Y.M.C.A., has been working on the problem for some 25 years. The approach being made in England is to take technically trained men who have practiced successfully in industry for several years and expose them to supplementary training which is essentially composed of the humanities. In addition to formal courses, the men are interviewed by experienced educators and given reading lists, again with the objective of making the men more flexible, better adjusted, and generally more able to cope with the human problems of their profession. When asked by what magic he convinced industrial executives to relinquish their men for the training course, Mr. Barker said simply, "I ask them to give me their technicians, and I promise to return 'persons.'" The program is successful. After a few years in industry, technical men begin to realize the inadequacy of their one-sided training, and the Y.M.C.A. plan gives them the chance to broaden their interests, and, in a sense, to become full fledged members of the human race.

The same general approach has been recently tried by the Bell Telephone Company, who recently sent a group of their executives and engineers for a full year's exposure to those same humanities at the University of Pennsylvania. Typical response from those having completed the course, as reported in *Harpers*, was that they made friends more easily, they felt more secure and confident in their jobs, they found there was more than one right solution to an industrial problem, and other comments which indicated the general increased awareness of the human elements of their work.

In conclusion then, we can point to concrete progress in the industrial and academic approach to the human problem in engineering work. On the operating level, we can only say from experience that if you will take the other fellow's place whenever you introduce a change that will affect him, you will do and say those human things which will tend to insure the success of your engineering work. In addition, of course, there is nothing to stop the practicing engineer from developing his own broadening program. It may come as something of a shock to find the many fields of non-technical study which can be of daily help in engineering work. Access to a good library and a kind of grim determination to discover for yourself what the B.A. has that the B.S. didn't

have time for is all that is required. But make it a pleasant experience—read, study, and discuss what interests you most, as long as it isn't along the line of your engineering specialty.

We, as individuals, may not be able to seriously affect the large scale technological and social movements, but in dealing with our own "Helens" and "Joes" we could do worse than heed the advice of Bertrand Russell, who said that what the world needed was a good dose of old-fashioned Christian compassion. This, coupled with a more "cultural" engineering outlook and a firm program of participation, should minimize the human failures in your technological effort.

We Ask You, Is This True?

It isn't what you don't know that causes all the woe.

Rather, it's what you're sure of that just isn't so.

Energy Official Makes Prediction

The United States will have a nuclear power capacity equal to its present total power capacity by 1977, it has been predicted by an official of the Atomic Energy commission.

The forecast was made by W. Kenneth Davis, director of the AEC division of reactor development, at the 17th annual American Power conference, sponsored by the Illinois Institute of Technology, in the Sherman hotel, Chicago.

Having a capacity of 100 million kilowatts, the nuclear plants probably will represent an investment of nearly $20 billion, he estimated.

He cautioned, however, that "we are still some distance from being able to show even on paper that we can build an economic nuclear power plant."

"The important point is that government and industry are firm in the belief that economic power plants can and will be built," he stressed.

Davis foresees three phases in the transition from conventional to nuclear power plants in the United States.

After an "induction phase" in which "it is anticipated some fairly large nuclear plants will be built, largely with private funds," an era of fast expansion will follow in which the growth of the industry will "snowball," Davis predicted.

When the expansion point is reached, he said, "it is not difficult to foresee the proportion of nuclear power plants to the total being built increasing from perhaps 5 per cent to 60 per cent in 10 years or less."

The final phase in the development, he added, would be a period of "slow saturation" when the proportion of new nuclear plants reaches "perhaps 60 or 70 per cent."

The AEC official stressed the necessity of getting private industry into nuclear power development on an incentive rather than a "cost-plus" basis.

(In "cost-plus" contracts, industry is reimbursed for all costs in a project and gets other predetermined returns but does not gain full rights to the completed project.)

"Though there is no 'law of nature' which says that nuclear power must be cheaper than conventional power, I believe that nuclear power can compete with and even be produced at lower cost than power from conventional fuels if its development is carried out on a sound basis," Davis said.

He added, however, that "under 'cost-plus' contracts we will never have the incentive that leads to the ingenuity and initiative required to get the costs down to a competitive level."

"Industry must do this reducing if it is to be done," Davis said.

Nuclear power expansion in this country will depend upon the "calculated risks" of individual producers, Davis declared, that is "the number of individual producers who decide that the construction and operation of nuclear power plants offer long-range advantages which outweigh the disadvantages."

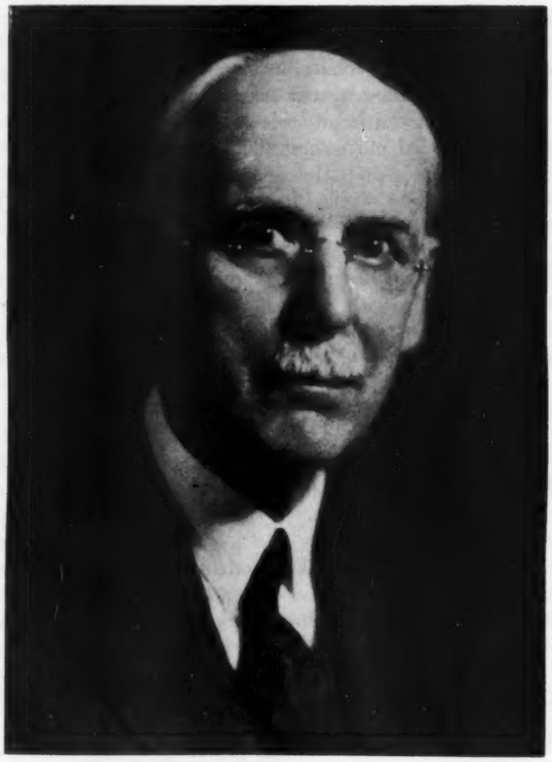
"This is the kind of decision which industry has had to make many times in the past—and the results have contributed much to our present standard of living," Davis asserted.

MEMOIR

to

Theodore Lincoln Condron

Died April 12, 1955



Theodore L. Condron was born in Washington, D. C., April 16, 1866. He graduated from Rose Polytechnic Institute, Terre Haute, Indiana, in 1890 with degree of Bachelor of Science and subsequently received a degree of Master of Science in 1892 and of Civil Engineer in 1896, from the same institution.

He established offices in Chicago in 1901 and over the years engaged in the design and supervision of railroad and highway bridges, factory and warehouse buildings of reinforced concrete and steel for many large and small industrial companies.

Mr. Condron participated in the initiation and development of reinforced concrete construction in the Chicago area and was an acknowledged authority.

His great ability with his high standard of ethical approach to engineering problems for his numerous clients generated a high regard by his associates in engineering and his services were constantly in demand to meet unusual needs. For this reason he was called upon for investigation of failures throughout the United States.

His membership in the various technical societies was much more than a nominal one. He actively participated and contributed the value of his knowledge and experience. Notably in this are his contributions and assistance to the Western Society of Engineers of which he was a member since 1894. In 1905 he was awarded the Octave Chanute Medal by this society. He was made a life member in 1926 and an honorary member in 1945.

He was the last surviving founder member of the Chicago Engineers' Club and was made an honorary member of that organization in 1938.

In the American Society for Civil Engineers he was a constant participant and contributor since he took membership in 1901. He was a director of this society from 1923 to 1925.

He was active in committee work of the American Railway Engineering Association which he joined in 1900. He was made a life member of this organization in 1936.

He participated in the early development of standards for structural steel for bridges and buildings as a member of the American Society for Testing Materials, which he joined in 1900.

In 1950 he received the Distinguished Service Certificate from the National Council of State Boards of Engineering Examiners in recognition of his more than thirty years of service as a member of the Illinois Structural Engineers Examining Committee. He was one of the authors of the original Engineering Registration Laws which were adopted throughout the country.

The high professional standing of Mr. Condron was universally supplemented by the high personal esteem of all who knew or were associated with him in any way.

He resided in Oak Park, Illinois, since 1905, where he was beloved by his friends and neighbors. He participated in the development of this village and served as a trustee.

He is survived by his widow, Grace L. Condron; two sons, both Civil Engineers, George T. and Arnold L.; his daughter, Mrs. Charles E. McGuire; and, in addition, grandchildren and greatgrandchildren.

H. H. MORGAN
ALBERT REICHMANN
June 23, 1955

On Training —

Letters from Leaders

In the last issue of Midwest Engineer we published another of about thirty letters received from leaders of Chicago-area firms concerning shortcomings noted in the engineers in their employ. Many of the letters also suggested what the engineers should do to correct their deficiencies.

Significantly, the engineer's technical training is generally considered adequate. In the broad area of Human Relations, however, engineers seem often to be "under achievers," according to the viewpoint of the industrial leaders as reflected in their letters.

We are printing several of these letters in this issue, as we shall do in future issues. Although the letters may be of greatest value to the younger engineers, we hope that all of the engineers who read them will benefit.

Here, then is the next letter:

Dear Mr. Becker:

This will acknowledge receipt of your letter of August 31 about the studies being made by your organization with regard to the educational needs of your members which will enhance their qualifications not only as supervisors in engineering work, but also as candidates for advancement into executive positions.

We shall be glad to give this question some thought and write you further as soon as possible.

Very truly yours,
(Signed)

Dear Mr. Becker:

Mr. .... has asked that I reply to your letter of August 31. The following comments are my own personal opinion but they are based on observations of technically trained people, not only in our organization but in many others as well.

I believe the factor that is needed most is the ability to work with people and get a job done. This means increased emphasis on personality development coupled with a keen business sense which enables the individual to keep the objective in mind.

In my contact with engineers I have become convinced that generally they are good citizens and are technically competent. I do believe that most technically trained people should devote a bit more of their time to the human relations aspect and should broaden their outlook as it pertains to other departments of their own companies and other business and civic organizations as well.

The work that you are doing is certainly commendable and I hope that these few remarks will be of some value.

Sincerely yours,
(Signed)

Dear Mr. Becker:

This will acknowledge your letter of August 31st.

I will be glad to see you if you will telephone and make an appointment where we can get together.

In view of the matter that you are interested in I think it might be much more helpful for you to talk to Mr. ....Chairman of the Executive committee of the.......... ....Company, as I think he has a better background as to the relationship of the engineering societies to the educational problem that is involved in training supervisors for engineering work and executive positions.

If you would like it I would be glad to put you in touch with him.

Very sincerely yours
(Signed)

Mining Scholarship Announcement Made

Nine Freshman Scholarships for the Missouri School of Mines and Metallurgy, at Rolla, Missouri, sponsored by the Alumni Association, have been announced by Dean Curtis L. Wilson, of that institution, and H. S. Pence, president of the Missouri School of Mines Alumni Association.

The scholarships carry a cash award of $500.00 for the Freshman year and are based upon High School scholastic standing and leadership participation, and the comparative results of engineering aptitude tests. With the exception of one scholarship there are no geographic restrictions. Applications for these scholarships must be on file prior to February 1st for entrance for the Fall semester.

'Low Temperature' To Be Studied

"Low Temperature Engineering and Research" will be the subject of a two-week Special Summer Program at the Massachusetts Institute of Technology from Aug. 8 through Aug. 19 during the 1955 Summer Session.

"Since the end of World War II," explains Professor Ernest H. Huntress, Director of the M.I.T. Summer Session, "the scientific effort directed toward the properties of matter at very low temperatures has increased at a striking rate. The program this summer at M.I.T. will acquaint engineers, physicists, and chemists with the results already achieved, the low temperature techniques and machines that have evolved, and the trend of recent experimentation."

The program will be under the direction of Dr. Samuel C. Collins, professor of Mechanical Engineering, assisted by other members of the M.I.T. staff.

Guest lecturers will include: F. G. Brickwedde, Chief of the Division of Heat and Power, National Bureau of Standards, Washington, D. C., B. F. Dodge, Professor of Chemical Engineering, Yale University, New Haven, Connecticut, V. N. Kirvobok, Development and Research Division, The International Nickel Company, Inc., New York City; H. O. McMahon, Director of Science, Arthur D. Little, Inc., Cambridge, Massachusetts; and J. Hatton, Assistant Professor of Physics, Harvard University, Cambridge, Massachusetts.

"Industrial oxygen and nitrogen, long important products of a low-temperature process," explains Professor Collins, "are turned out in ever-increasing volume. Liquefied gases are finding extensive application in research laboratories as well as in industry in securing and maintaining high vacua and in providing an environment for experiments.

"The decreased cost of liquefied gases as techniques and machinery have improved," he continues, "makes possible relatively large-scale operation compared with that of some years ago."

All these, he says, are factors in M.I.T.'s decision to present this program during the coming summer.

Lecture topics will include temperature measurement and control, principles of low-temperature refrigeration mechanical properties of metals at low temperatures, paramagnetism and adiabatic demagnetism, superconductivity, separation of air by distillation, and thermal and electric conduction. Members of the program will participate (by small groups) in the normal routine of the M.I.T. Cryogenic Engineering Laboratory.

Other M.I.T. staff members assisting Dr. Collins in conducting the program are: C. A. Swenson of the Cryogenic Engineering Laboratory; C. C. Stephenson, Associate Professor of Chemistry; and M. A. Herlin, Assistant Professor of Physics.

Registrants may reserve rooms in the Institute's dormitories during the program. All M.I.T. recreational facilities, including the swimming pool and the popular sailing pavilion on the Charles River Basin, will be available for their use.

Full details and application blanks for this Special Summer Program on Low Temperature Engineering and Research may be obtained from the Summer Session Office, Room 7 - 103, Massachusetts Institute of Technology, Cambridge 39, Massachusetts.

This Color Code Is the Latest Mode

California has introduced another innovation—color-coated flower seeds that make it simple to tell the color of the flower's bloom, *Chemical Week* reports. The tinted seeds, sold at a Los Angeles store, currently include 11 vegetables, in addition to 11 varieties of flowers.

CRERAR LIBRARY

News and Notes

Summer months have brought the usual round of professional conferences at which Crerar has been represented. June 12 to 16 saw the Special Libraries Association meet in Detroit with those present including Hazel Keener, Asst. Chief, Technology Dept., and Ellis Mount of Research Information Service. The American Library Association held forth in Philadelphia July 4 to 8, with William S. Budington, Associate Librarian, present. Attending some meetings was Herman H. Henkle, Librarian, who also represented Crerar in the Association of research Libraries.

* * *

During July the main lobby exhibit case will have a display illustrating manufacture and applications of fibre glass, for use in the home and in industry. The WSE lobby case is devoted to a 16th century work on instruments and machines. *Theatrum Instrumentorum*, of which this first Latin edition was published in Lyon, 1578, was written by Jacques Besson, a mathematician and tutor. Some of the earliest examples of machine tools are pictured in engravings; copies on display illustrate screw cutting and cam template lathes, worm gear drives, and other forerunners of today's elaborate equipment.

* * *

Visitors to the Library during May and June illustrated through their national origins the world-wide reputation of Crerar. Countries represented in-

cluded Sweden, Finland, Japan, Venezuela, India, Canada, Greece, and West Germany. The greater number were librarians, but others representing universities and governments spent some time investigating the services and resources which might assist in research in their homelands.

Atomic Power Section Featured at Exposition

An atomic power section will be a feature of the Chicago Exposition of Power and Mechanical Engineering at the Chicago Coliseum, Nov. 14 to 18. The exposition will be held under the auspices of The American Society of Mechanical Engineers, whose Nuclear Engineering Division will provide a program of technical papers in the field of atomic power for the Society's concurrent meeting. Exhibits in the atomic power section will disclose phases of the application of atomic energy to power of special interest to mechanical engineers.

Instrument Measures Impact Effect

A new instrument for measuring the effect of impact on metals and plastics has been developed in the Research Division of the New York University College of Engineering.

The instrument, which is called the "impact tube," describes impact in terms of dynamic stress-strain relationships. To engineers, this is the "fingerprint" of impact on the metal. Stress-strain results from past studies have been mixed with the effects of waves propagated by sudden shock. In the new instrument the two elements are separated.

The impact tube consists, essentially, of a 14-foot-long steel tube 18 inches in diameter. The tube is divided into three chambers, a static chamber, and firing chamber. The test specimen, a circular metal plate, is mounted between the static and dynamic chambers.

The other end of the dynamic chamber is sealed with a plastic diaphragm supported by a pneumatically controlled piston. Pressure is built up equally in the static and dynamic chambers.

Impact is applied by a carefully controlled simulated explosion. First the diaphragm is ruptured. This sends an expansion wave from the mouth of the dynamic chamber to the specimen. Pressure at the specimen position drops in about one one-hundredth of a second. The onrushing pressure from the static chamber slams against the specimen. This constitutes the impact loading. The force of the impact can be varied by changing the length of the dynamic chamber.

Knowledge of the stress-strain response of metals and other materials is essential in the design of structures subject to sudden loads. These include supersonic aircraft, equipment and buildings that may be under bomb blast, the landing gear of aircraft, even automobile parts that are stamped out by heavy presses.

Information on how materials react under static loading (slowly applied) is so extensive that, as a matter of course, the static response of various materials is tabulated and supplied by metals and plastic manufacturers to engineers working with the material. With further development of impact tube techniques, data on stress-strain relationship of materials under sudden loads may be as commonly disseminated.

Wave propagation effects in the impact test are minimized by the flatness, or planarity, of the expansion wave created in the dynamic chamber. With the new instrument, the effect of impact can be measured over the entire face of the specimen. Information is transmitted from pressure gauges and transducers attached to the specimen and an oscilloscope. Signals on the oscilloscope are photographed as they move across the screen.

To date, scientists in the NYU Engineering Research Division have studied the response of aluminum, steel, and titanium alloys to various loads and loading speeds.

Dr. George Gerard, assistant director of the Engineering Research Division, invented the impact tube. Research is being conducted under sponsorship of the Office of Ordnance Research, United States Army.

Professional Directory

Penfold Appointed To Hold Texas Post

Norman C. Penfold, chairman of Southwest Research Institute's department of engines, fuels and lubricants research, has been appointed vice-president of Southwest Research Institute, San Antonio, Tex.

As vice-president, Penfold will continue to direct the automotive, fuels, and lubricants research and the photo laboratory at Southwest Research Institute. He directs research in petroleum application and utilization, mutual adaptation of engines, fuels, lubricants and application as prime movers. His special fields are internal-combustion engines, fuels and lubricants, use of engines as research tools in evaluation of fuels and lubricants, heat power and combustion, automotive petroleum products and research management.

Penfold was chairman of the mechanical engineering research at Armour Research Foundation before joining Southwest Research Institute in 1949. He has served as mechanical designer, experimental engineer and chief engineer for the Republic Heaters Sales Co. and experimental and development engineer for the Republic Flow Meters Co. of Chicago.

He received his B.S. and M.E. degree from Armour Institute of Technology and has published a number articles.

Engineering Societies Personnel Service, Inc.

New York Chicago Detroit San Francisco

These items are from information furnished by the Engineering Societies Personnel Service, Inc., Chicago. This SERVICE, operated on a co-operative, non-profit basis, is sponsored by the Western Society of Engineers and the national societies of Civil, Electrical, Mechanical and Mining and Metallurgical Engineers. Apply to ESPS, Chicago and the key number indicated. Prepared ENGINEERS AVAILABLE advertisements limited to 40 words, with typed resume attached may be submitted to ESPS Chicago by members of Western Society of Engineers at no charge.

If placed in a position as a result of an Engineers Available or Position Available advertisement, applicants agree to pay the established placement fee. These rates are available on request and are sufficient to maintain an effective non-profit personnel service. A weekly bulletin of positions open is available to subscribers. Apply ESPS Chicago.

POSITIONS AVAILABLE

W-1637 Sales Engrs. 2 with Mech. or Met., training and sales exp. in metal products fields to sell powder metallurgy products. Sal: $4800 plus comm. & expenses. Loc: Pref. resident of Milw. or vicinity to cover Wisc. & Iowa & parts of adjacent states. OR resident of Indianapolis or Louisville & vicinity to cover Ind., Ky., Southern Ill., & parts of adjacent states.

S-885 Sales Trainee — Lubricants, recent grad., to 2 yrs. exp. definite interest & possible academic emphasis on lubrication; demonstrated aptitude & interest in sales. Field & offic. training about 2 yrs., including retail sales; Jr. sales 3 yrs. on small comml. accounts; final assignment to large industrials. Salary: Open. Bay Area.

S-931 Jr. Salesman — Petroleum Products 24-30, degree, sales aptitude and desire to learn lubrication engrg. sales to industrials. Willing to work either S.F. or L.A. Car furnished $365/mo. start. $400 in yr. Perm.

C-3004 Chemical Engineer Chem. Engr. Age: up to 40. 4 plus yrs. exp. in engrg. work with chemical processing plants. Knowledge of petro-chemical and electro-chemical helpful. Duties: engrg. work in general with chemical processing plant. for a mfger. of gases. Sal: Up to $8000 per yr. Location: Chicago.

C-3008 Purchasing Chem. Age: up to 32. 2 plus yrs. exp. in chemistry or chemical work. Duties: purchasing chemical raw materials. For a rubber mfger. Sal: $425 to $450. Employer will negotiate fee. Loc: South West Chicago Suburb.

C-3021 Instructor BS in Engrg. Age: to 30. No exp. necessary. Know: Engrg. drawing, mechanics. Duties: teach courses in drawing, engrg. problems (slide rule) for Freshman and some applied mechanics. Sal: $3600-$3900 for 9 mos. Loc: Colorado.

C-3022 Research Chemical Engr. Chem. Engr. Age: up to 36. Recent grads and better. Knowledge of pilot plant eqpt. and apparatus. Duties: applied industrial research in translating results of research to pilot plant and production, analysis of problems and applying mathematical principles and use of mechanics of chemical engineering to industrial process and product development. For a paper mfger. Sal: $375 to $700 per mo. Loc: Wisconsin.

C-3103 Associated Editor BS Mech. Elect. or Chem. Age: 25-30 2 plus yrs. exp. in industry. Knowledge of photography desirable. Duties: to train for work as associated editor for publication covering the plant management, maint. and power plant fields. To start will work on analyzing mail and spot news. Must be draft. exempt. Sal: $5000 to $6000. Employer will negotiate fee. Travel: 25%. Loc: So. Michigan.

C-3127 Mechanical Analyst Chem. E. or ME Age: 30-40. 4 plus yrs. exp. in experimental test work in heat transfer or in heat engine work. Knowledge of thermodynamics. Duties: over all thermodynamic analyses of proposed systems for economic consideration. The same for eqpt. design. Also stress and shock analyses of process equipment and pressure vessels. For a mfger of heating eqpt. Sal: $7380 to $9960 per yr. Location: New York.

C-3212 Ind. Engr. ME or Chem. E. Age: 30-35. 3 plus yrs. exp. in utility survey and cost work. Duties: study consumption and costs of coal, gas, acetylene, water, steam, heating, ventilating and other miscellaneous assignments & make recommendations to improve or reduce costs. For Mfr. of valves. Sal: $6-7000 Loc: Chicago.

C-3229 Sales Engr. Eng. Degree. Age: 30-35. 2 plus yrs. exp. in sales or application of htg. vent., air cond. or allied eqpt. Duties: technical selling of above named eqpt. calling on consulting engrs., architects, contractors, jobbers & industrials. For Mfr. of htg. vent. & Air Cond. Sal: $6500 & Comm. Loc: U.S. Considerable Travel. Car Req'd.

ENGINEERS AVAILABLE

246 MW Expediter 35 15 mos. expediter, coord. for mach. shop. Follow up on projects. Mach. shop suv. 15 mos. design and devel. new & improve methods, packaging and handling prod. $5200 Midwest.

247 MW Gen. Mgr. 49 CE 1 yr. project mgr. domestic housing constr. 3½ yrs. contract insp. on chem. plant constr. 21 yrs. consult. gen. constr. $12,000 U.S.

249 MW Estimator 31 ME 41 mos. material take-off, charge of non destructive testing, time study and cost accounting of direct labor, on piping systems, heating & underground piping. $650 U.S.

250 MW Sales Engr. 32 ME 7 yrs. design and development of aluminum job shop commodities. 1 yr. charge of residential and commercial htg. layouts, & purchases of assoc. eqpt. $7200 Midwest.

251 MW Development 33 ME Met. 4 yrs. design and layout of materials handling eqpt., tank turret, pumps, and tractor transmission. 1 yr. res. aircraft thermo stress problems. $6000 Midwest.

252 MW Development 30 ME 4 yrs. organize and coord. quality control program, design functions with sales, engrg. & production depts. Reports, estimate design and development cost, controls and products in pneumatic control line. $7200 Midwest.

253 MW Sales 46 15 mos. designer, checker on special machine tools. 15 mos. esp. for engrg., tooling & production. 18 mos. Sales of heating, vent., eqpt. $7500 U.S.

254 MW Constr. 27 CE 3 yrs. architectural field appraiser on properties of various kinds. 6 weeks resp. for constr. of streets & sidewalks for muncipality. $5600 Chicago.

255 MW Chem. Engr. 42 MSIE 5 yrs. admin. client contact market res. & analysis, new developments, technical editing and correspondence 9 yrs. dev. engr. & tech, sales of optical goods. 15 yrs. time & motion study, machine shop, sub and final assembly work on radios and TV's. $10,000 Midwest.

Preliminary Program Established

A preliminary program has been established for the World Symposium on Applied Solar Energy to be held at the Westward Ho Hotel in Phoenix, Ariz., Nov. 1-5, 1955.

Designed for the interest of both science and industry, the program and work sessions of a more technical nature are expected to attract attendance in excess of 800 from throughout the world.

Sponsors of the meeting are the Association for Applied Solar Energy, Stanford Research Institute and the University of Arizona.

Among the papers scheduled by noted authorities on solar energy are "The Sun's Energy," Dr. Farrington Daniels, University of Wisconsin; "Survey of the Domestic Uses of Solar Energy," Dr. H. C. Hottel, Massachusetts Institute of Technology; and "Space Cooling With Solar Energy," Dr. George O. G. Löf, Denver, Colo.

Contributions from abroad will be made by Professor Felix Trombe, Laboratoire de l'Energie Solaire, Paris, France, speaking on "High-Temperature Furnaces"; R. N. Morse of the Commonwealth Scientific and Industrial Research Organization, Australia, discussing "Solar Water Heaters"; and Dr. Hiroshi Tamiya of the Tokugawa Institute for Biological Research, Tokyo, presenting a paper on "Chlorella for Food."

Also among the foreign program participants will be Dr. Harold Heywood of the University of London and Dr. Austin Whillier of the South African Council for Scientific and Industrial Research, who will take part in a special panel discussion on solar house heating.

Dr. J. E. Hobson, director of Stanford Research, will make a discussion on "The Economics of Solar Energy" at the outset of the five-day meeting.

One program section will deal with plant life as a means of improving food and fuel benefits from sunlight. In addition to the paper of Chlorella by Dr. Tamiya of Japan, announced subjects and authors include:

"Food and Fuel from Solar Energy," Dr. F. A. Brooks, University of California; "Chlorella for Animal Food," Dr. Jack Meyers, University of Texas; "Engineering for Algae Culture," Dr. A. W. Fisher, Jr., Arthur D. Little, Inc., Cambridge, Mass.; and "Solar Energy Utilization by Higher Plants," Dr. Paul C. Mangelsdorf, Harvard University.

Dr. Maria Telkes of New York University will discuss "Solar Stills" and Dr. R. C. Jordan of the University of Minnesota will present material on "Mechanical Energy from Solar Energy."

Conversion techniques and prospects will have a place on the program. Dr. Paul Erlandson of Southwest Research Institute will have a paper on "Direct Conversion of Solar Energy"; Dr. L. J. Heidt of Massachusetts Institute of Technology will present material on "Converting Solar to Chemical Energy"; G. L. Pearson of Bell Telephone Laboratories, Inc., will talk on "Photovoltaic P-N Couples."

Participating with Dr. Heywood and Dr. Whillier in the panel on solar house heating will be Dr. Löf, Dr. Telkes, Philip Sporn of the American Gas and Electric Service Corp. and Raymond W. Bliss, Jr. of the University of Arizona.

There will also be a round-table session on architectural problems associated with solar energy utilization and a panel on other mechanisms of energy conversion.

Special work sessions are being planned with emphasis on technical phases on solar energy untilization. Volunteer papers will be invited. The strictly technical program is being developed under the direction of Dr. Dan McLachlan of Stanford Research Institute.

General chairman for the symposium is Lewis W. Douglas of Tucson and New Arizona Bank and Trust Co. Vice chairman and program director is Merritt L. Kastens, assistant director of Stanford Research Institute.

Headquarters for the symposium during its planning phase is Suite 204, Mayer-Heard Building, Phoenix.

If you go to law for a sheep you will lose your cow. —Old Iberian Proverb

Primary Highway Problem Defined

Better roads, not more of them, is the immediate highway problem in the United States, guests at the dedication of the new Asphalt Institute building on the University of Maryland campus were told May 5.

The speaker, former Congressman Jennings Randolph, now assistant to the president of Capital Airlines and an official of the American Road Builders Association, pointed out that the nation's rural road system reached a total of approximately 3,000,000 miles shortly after World War I—and has changed very little in length since then.

"What needs to be done," said Randolph, "is to improve our present highway system. Dirt roads must be paved, narrow roads must be widened, winding roads must be straightened, tired old roads must have a face-lifting, and expressways and ample parking areas must be built to serve the metropolitan centers."

He emphasized, however, that in some instances new, divided and limited access parkways must be constructed where extremely heavy volume of traffic has made salvage of present road facilities economically unfeasible.

Randolph, who served 14 years on the House Roads Committee before entering private industry, observed that only 919,000 miles of the nation's 3,366,000-mile highway network are paved—less than one-fourth.

He cited the prediction by the Department of Commerce that our highway system probably will change very little in length in the next 15 or 20 years, but that a major overhaul and modernization program is surely needed.

"Two years ago it was estimated the nation had an investment of $75.5 billion in highway construction since 1914," said the speaker. "But better than $15 billion of that has been abandoned and the remainder has depreciated to the point where our total investment in roads had shrivelled to $36.9 billion at the start of 1953."

"All of which means our highway system has been wearing out faster than we can replace it, although we have started to recapture some lost ground in the last few years."

Meanwhile, he added, the nation's 58 million vehicles are slowly grinding to a halt on a 1925 highway system built to accommodate only 17 million vehicles.

"We cannot afford," said Randolph, "to make the same mistake again. We cannot replace that obsolete highway network with a new one geared to the requirement of 1955. Instead, we must build for the future. We must replace this 1925 system with one designed to handle the expected flow of 85 million or 90 million vehicles in 1975."

Here, said the speaker, is the challenge that the research and development engineers of such centers as The Asphalt Institute must meet. Never, he added, was the need greater for long technological strides in the science of road-building. Never was the need greater, he said, for getting the last penny's worth of mileage out of the road-building tax dollar.

"Tomorrow's highways are being built in the laboratories today," Randolph declared. "The engineers and technicians of The Asphalt Institute have played a vital role in advancing the technology of road construction. Even greater advances must be made if this dynamic and highly mobile nation is going to lick its critical transportation problem."

Establish Acoustics Scholarship at IIT

An $800 scholarship has been established at Illinois Institute of Technology for a senior or graduate student specializing in acoustics.

The scholarship, which covers tuition costs for a year, was created by Shure Brothers, Inc., Chicago manufacturers of microphones and acoustic devices. First award will be made for the 1955-56 scholastic year.

Known as the Shure acoustics scholarship, the grant will be awarded on the basis of scholarship, need, and interest in electroacoustics.

Need Better Combustion Process

Improvement of combustion processes, as a means of reducing smog, should be "the first major goal of science and technology," Dr. Lauren B. Hitchcock, president of the Air Pollution Foundation, declared July 1 in an article appearing in the July issue of *Scientific Monthly*.

Writing on "Some Aspects of the Urban Air Polution Problem" for the national scientific magazine, Hitchcock and Helen G. Marcus, editorial assistant with the Foundation and co-author, emphasized that currently inadequate combustion methods are a major cause of smog.

"As our cities expand, more public and private transportation is needed, which means more motor vehicles and increased power requirements," the article explained.

"This is the age of mechanization, and virtually all machines require power produced by a combustion process. Our present combustion processes are all very imperfect and contribute by far the major part of man-made polution.

"There is mounting evidence that organic compounds from combustion react in the presence of oxides of nitrogen and sunlight to produce oxidized organic compounds and ozone; that some of these organic oxygen complexes may be responsible for eye irritation, plant damage, reduced visibility and bad odors.

"Improvement of combustion processes should be the first major goal of science and technology."

The article, in addition to presenting the views of the authors, represented a summary of the main points contained in six technical papers presented last December 30 at a Symposium on Air Pollution conducted by the American Association for the Advancement of Science at its 121st annual meeting at Berkeley.

The Foundation president declared that "the scientist and engineer have a deep-seated responsibility to deal with the unwelcome by-products of their inventions."

"The growing concentration of men and machines evolving new processes and products is responsible for nuisance —and even hazard-carrying pollution, which must be corrected if urban civilization is to continue," they wrote.

"Surely the same technical genius which created these benefits—and unintentionally these pollutants—can contrive the cures."

The authors warned that much preparatory work still needs to be done before adequate remedies for air pollution problems can be prescribed:

"We must analyze the air to identify the pollutants and their sources, to understand the changes which take place in the air. We must equip ourselves for this research. The work done to date has only indicated the magnitude of the problem ahead of us.

"After we familiarize ourselves with the air around us, we must invent practical remedies to combat pollution. In the absence of these, legislation can do little towards the improvement of pollution conditions."

Time Study Clinic Set for November

The Nineteenth Annual Time and Motion Study and Management Clinic sponsored by the Industrial Management Society will be held on Nov. 9-11 at the Sherman Hotel, Chicago. More than 2,000 industrial engineers, works managers, plant superintendents, and production executives are expected to attend the technical sessions, and industrial exhibits.

Topflight industrial leaders from all over the U. S. will discuss the latest developments in the fields of time study, motion economy, job evaluation, methods, production control, plant layout, materials handling, and human relations.

Feature of the event will be the Annual Methods Improvement Contest, with awards to companies and colleges for outstanding advances in industrial engineering techniques and applications.

Inquiries should be addressed to the Industrial Management Society, 35 East Wacker Drive, Chicago 1, Illinois.

A New Way to Say It

Dollars may go quickly if there is no sense.

Reviews of Technical Books

Automatic Controls

Industrial Automatic Controls, by Millard H. La Joy, Prentice-Hall, Inc., New York, N. Y. 278 pages. Price $6.65.

This book is intended for engineers in the manufacturing and chemical industries to understand the fundamental aspects of Industrial Automatic Controls. It contains chapters on simple two-position controls, floating and rate controls and combinations of different circuits. It also deals extremely well with pneumatic, hydraulic, electric and electronic control circuits. The last chapters introduce the reader to the theoretical analysis of the process and of the controller which is of interest to the engineer who wishes to go on to more complex systems.

Each phase of the book is well illustrated with schematic sketches of automatic control circuits as well as with graphical charts of valve movements and of input and output relationship. The reader will find problems to solve at the end of each chapter and the "Glossary of Terms" will be helpful to the one who is not too familiar with all the expressions used in the book.

The mathematics required for most of the chapters does not go beyond calculus and only the chapters dealing with the theoretical analysis of the process calls for use of differential equations.

This book will provide interesting reading and will be of help to anyone involved in problems of Industrial Automatic Controls.

C.W., W.S.E.

Power System Analysis

Elements of Power System Analysis, by William D. Stevenson, Jr., McGraw-Hill Book Co., New York, N. Y., 370 pages.

This book is primarily a text for advanced students in Electrical Engineering. It consists of fifteen chapters and an appendix of tabular material.

Following an introduction outlining the nature and scope of the problem, the next six chapters deal with the calculations of circuit parameters, voltage and current relationship, generalized constants, and circle diagrams.

Power system stability is treated in the final chapters and preceded by the presentation of the theory of symmetrical components, sequence impedances, and networks.

Per unit computations are developed and used throughout the latter part of the text. Developments are well illustrated with examples and a good selection of problems. The appendix contains excellent tables on the characteristics of conductors, typical characteristics of synchronous machines, transformer impedances, and typical power transmission lines.

O.W.E., W.S.E.

Equipment for Buildings

Mechanical and Electrical Equipment for Buildings, by Charles M. Gay, Charles De Van Fawcett, and William J. McGuinness, John Wiley & Sons, Inc., New York 16, N. Y. Third Edition, 1955. 564 pages. Price $8.50.

This book provides a basic guide to design, specifications, installations, operation, and maintenance of the more important types of machinery, acoustical materials, and supporting media.

The revised standards and procedures of the last ten years have involved a page-by-page reconsideration by the authors, resulting in extensive changes in both the mechanical and electrical discussions. On the mechanical side, there is now an entirely new chapter on radiant heating, and up-to-date information on pumps, baseboard and forced warm air heating, zoning systems and controls for hot water heating, and the Metro system of steam heating. The modernized electrical material incorporates the latest details on elevators and escalators, a-c and d-c theory, and underfloor duct systems. To help further in solving layout problems and assign typical floor space and ceiling elevations, important dimensions and weights of equipment are now provided. These and other points combine to offer a fruitful working source for architects, building owners and managers, contractors, maintenance men, and all those concerned with keeping buildings on a par with modern requirements.

R.C.

Sonics

Sonics, by Theodor F. Hueter and Richard H. Bolt, John Wiley & Sons, Inc., New York 16, N. Y. First Edition, 1955. 456 pages. Price $10.00.

This book undertakes an exposition of analysis, testing, and processing of materials and products by the use of mechanical vibratory energy. It has the sub-title of "Techniques for the Use of Sound and Ultrasound in Engineering and Science."

With the unity of sonics as their keynote, Hueter and Bolt have drawn upon material from physics, engineering, and electronics as they relate to four major points. These are the fundamental physics of vibration and sound, design principles of electroacoustic and fluid-dynamic transducers, choice of sonic variables for systems engineering, and special techniques for testing and processing. This information is cast within the framework of basic physics so that the common features of seemingly unrelated techniques and devices become apparent.

In spanning the entire frequency range, the authors are primarily concerned with industrial applications and therefore give precedence to questions of technique and instrumentation. The applications are divided into sonic processing and sonic analysis, with typical examples selected to illustrate operating principles. Wherever possible, a discussion concludes with simplified engineering formulas and practical instructions for their application. Similarly, the results of equations are frequently condensed into tables and design curves for immediate engineering use.

R.C.

WSE Personals

Harold A. Bergen, MWSE, formerly senior associate editor of *Consulting Engineer* magazine and associ te editor of *Industry & Power* has been appointed editor of *Industry & Power* by John Paul Taylor, publisher. The John Paul Taylor Publishing Company recently purchased I&P.

Bergen, with years of industrial and editorial experience, is well known in engineering circles. Besides the Western Society, he is a member of American Institute of Electrical Engineers, Institute of Radio Engineers, National Society of Professional Engineers, Michigan Society of Professional Engineers, Eta Kappa Nu (electrical engineering honorary), Tau Beta Pi (engineering honorary), and Pi Delta Epsilon (journalism honorary). He is a member of the AIEE Industrial Power Systems Committee and is a member of the standing committee for the Review of the AIEE's Red Book ("Electrical Power Distribution for Industrial Plants").

* * *

Hugh J. Fixmer, MWSE, has just retired as assistant chief engineer of streets, Bureau of Streets, for the City of Chicago, after serving the city for over 50 years. During the past 45 years he was engaged in the design and construction of paving projects.

* * *

John T. Rettaliata, MWSE, president of the Illinois Institute of Technology, was recently given a citation at the final meeting of the season of the Chicago group of the National Conference of Christians and Jews at the Sherman hotel. Dr. Rettaliata served as Brotherhood Week chairman for the state of Illinois.

* * *

Harold R. Heckendorn, MWSE, formerly an assistant superintendent of manufacturing engineering, is now assistant superintendent of production control and results in the office of the vice-president of manufacturing of the Western Electric Co., Chicago.

A registered professional engineer, he is an active member of the Western Society and the American Institute of Electrical Engineers. He was president of the Electrical society, completing his term in that office earlier this year.

Heckendorn was graduated from Kansas State College in 1934 with a B.S. degree in Electrical Engineering. Subsequently he studied for two years at the graduate engineering school of Northwestern University. He joined Western Electric in 1941, and was assigned to manufacturing and electrical engineering duties. In 1951 he became a department head, and in 1952 he was appointed to be an assistant superintendent.

* * *

Fraser, Weir and Associates, Inc., have opened new offices at 20 North Wacker Drive, Chicago, as consultants in Industrial Engineering and Plant Design with special emphasis on installation of controlled maintenance systems for all types of industrial, transportation and mining facilities. **Paul Weir** is a member of WSE. The Fraser, Weir organization announces that it now makes available to all industries, both in the U. S. and abroad, the combined facilities of the Paul Weir Company, the services and techniques developed by H. H. Fraser and Associates Ltd. and the experience of Stewart Morgan, who have successfully introduced their methods of engineered maintenance into the plants, factories, mines and shops of a wide variety of clients in the U.S.A., Africa, and the Near East.

* * *

Fred H. Johnson, MWSE, has received the appointment of engineering consultant to the vice-president in charge of planning of the Inland Steel Co. The Inland Steel Company's new office building to be erected in the Chicago Loop, and scheduled to be started in the near future, is one of Johnson's first problems as consultant for the company.

* * *

David W. Harris, MWSE, was recently honored on the completion of his first ten years as president of Universal Oil Products Co. The company is located at Des Plaines, Ill. Slides, made from photographs, were shown to the approximately 100 friends at the Sheraton-Blackstone hotel. The slides were of scenes in which he appeared, and covered much of his career. Unknown to him, the slides were prepared from pictures obtained from his family.

Phonograph Record Saves Company Time

A long-playing record that gives directions for checking a complex cable for circuits after assembly, has saved 89 per cent of regular checking time for a Pennsylvania engineering company, according to *American Machinist.* The LP disc, which dictates a sequence of instructions for checking the entire circuit, replaces a previously-used direction sheet which, although workable, required two and one-fourth hours for checking each cable, as compared to 15 minutes (including pauses in the record allowing the inspector to make connections) for the recording.

Something New

"Skindiving" equipment, normally used by swimming sportsmen, has taken its place in the building contractor's utility kit, *Engineering News-Record* reports. The equipment recently was used with outstanding success to complete an apparently hopeless sewer installation.

Obituaries

The Western Society of Engineers has recently been notified of the following deaths:

Frank W. Johnson, the Western Society of Engineers has just learned, died August 26, 1954. He had been a member of the Society since 1949, and was interested especially in the Hydraulic, Sanitary and Municipal Engineering, and the Mechanical Engineering sections. Mr. Johnson had been president of the Johnson Brothers Heating Company in Chicago.

* * *

Charles S. Walton, a design engineer with the MacDonald Engineering Company in Chicago, died on April 1, 1955. He had become a member of the Western Society in 1920, and his main interest was in the Mechanical Engineering Section.

* * *

H. D. Worthington, assistant manager, Wire Rope and Construction Materials Department of the American Steel and Wire Division, died June 4, 1955. Mr. Worthington, who joined the Society in 1950, was a resident of Evanston.

* * *

Charles A. Pratt, vice-president of Goodman Manufacturing Company, Chicago, died June 15, 1955. A Life Member of the Western Society, he had become a member in 1903. He, too, had been a resident of Evanston.

* * *

Ray C. Brown, a Life Member of the Society since 1951, having become a member in 1921, died on June 22, 1955. Mr. Brown was chief engineer for Burnham & Hammond, Inc., Chicago.

* * *

Major Edward A. Miller, who had been with Headquarters, 312th Fighter Bomber Group, Clovis Air Force Base, in New Mexico, was killed in an airplane crash at Alamagordo, N. M., on June 30, 1955. Major Miller had been in service since January 12, 1951. He had been a member of the Western Society of Engineers since 1947, and had been particularly interested in the Fire Protection and Safety Engineering Section of the Society.

Illinois Central Scores a First

The Illinois Central scored another "first" among railroads July 7 with the installation and actual use of the industry's first electronic "engineer." The Illinois Central is utilizing the new machine for processing accounting data. A second machine of this type has been ordered by the Illinois Central with delivery scheduled for sometime during the fall.

The giant electronic "engineer" is housed in three large console cabinets. Heat generated by the machine during its operation makes it necessary to install the equipment in a special air-conditioned room where the temperature and humidity can be controlled.

A unique feature of the electronic processing equipment is its magnetic drum "memory." A magnetic drum, four inches in diameter and sixteen inches in length, is capable of "remembering" information recorded on it for 20,000 digits at 2,000 locations on the drum. A different set of instructions is fed on the drum for each job to be handled. When work is fed into the machine, these instructions determine the processing of data for that particular job. The drum revolves at a speed of 12,500 revolutions per minute thereby enabling it to "answer" "questions" posed to it in less than three-thousandths of a second.

In payroll accounting, for example, compensation rates for various positions, withholding tax and retirement tax data, miscellaneous deduction information and any other necessary information, are recorded on the magnetic "memory" drum. As punched cards covering various employes' jobs are fed into the machine the memory device makes the proper calculations for each individual employe. This is in contrast to the present mechanized system which requires multiple sortings of cards into similar classifications. A master card for each classification controls the action of the calculator. The new machine makes these many intermediate steps unnecessary.

The Illinois Central appointed a committee of three accounting officers to study the adaptability of the new machine to railroad accounting work early in 1954. The committee was trained in programming work schedules for electronic processing at basic and advanced schools conducted by the International Business Machines Corp. Following this training, the committee worked out a program to adapt Illinois Central accounting work to the machine. These programs were then tested on a machine set up at the IBM factory where their workability was proved.

The railroad has developed plans to extend the use of these electronic machines to all of its accounting procedures and is studying the possibilities of adapting them to other phases of railroad work. The machines will enable the development of many types of information which will help to give a quicker and more complete picture of the railroad's operations.

On Values

What is there more valuable than Gold? Diamonds. Than Diamonds? Virtue.

—Poor Richard's Almanack

Ground Is Broken For Chicago Reactor

A force "greater than the atomic bomb"—peacetime nuclear energy—was carried a step further here June 13, as construction began on a building to house the nation's first industrial research reactor.

Ground was broken near 35th and State streets for a $1,750,000 five-floor research building at Armour Research Foundation of Illinois Institute of Technology.

In addition to the nuclear reactor, the building will house the Foundation's physics and electrical engineering research departments. It will be completed by April 1, 1956.

James D. Cunningham, MWSE, chairman of the Foundation's board of trustees and president of Republic Flow Meters company, said "the final impact of non-military application of atomic energy in changing the course of world affairs will be even greater than the atomic bomb."

But, he said, there are many yet unknown benefits of atomic energy which now can be exploited with the Foundation's nuclear reactor.

Dr. John T. Rettaliata, MWSE, president, and Dr. Haldon A. Leedy, director, also spoke at the ceremonies for the new building, which will be the 20th modern structure to go up on the Illinois Tech campus in the last decade.

Rettaliata said addition of the building to the facilities of Armour Research Foundation marks the half-way point in a $45 million program for the development of an educational-research area that "shall be second to none."

Paschen Contractors, Inc., Chicago, began construction of the building's concrete foundation. The contract for building the superstructure will be let in the near future.

Metalworking Is Up

Metalworking production was maintained on a higher plateau throughout the first half of 1955 than at any other period in peacetime, *American Machinist* reports. The rate during the past six months was surpassed only in World War II and for a short time in 1953, when defense production was at its height.

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Sky Information May Save Fuel

A device that will provide more accurate meteorological information for weather forecasting and will result in the reduction of fuel consumption in high-speed aircraft is being developed at Armour Research Foundation of Illinois Institute of Technology, Chicago.

In a project for the Air Research and Development Command, scientists in the Foundation's heat-power research department are studying the application of vortex tubes for the measurement of free air temperature from planes traveling at supersonic speeds.

This instrument will enable the new high speed weather observation planes to obtain more accurate measurements of air temperature for predicting weather conditions, according to Jack C. Hedge, project engineer.

Present methods of collecting this information have been found to be inadequate for high speed aircraft, he said.

The vortex thermometer also will enable planes to locate jet streams, resulting in the reduction of fuel consumption. A plane flying at an air speed of 200 miles an hour can increase its ground speed to 300 miles by flying in a 100-mile-an-hour jet stream.

Other possible applications for the device are in military fire control systems and for refrigeration. Use of the tube for refrigeration has been considered at the Foundation but has been found to be rather inefficient except in special applications.

Purpose of the ARF study is to develop an instrument capable of measuring the true free air temperature for planes traveling 1½ times the speed of sound at altitudes ranging from sea level to 60,000 feet.

The vortex tube is the first known practical device that will measure this temperature directly, although indirect means have been used previously, Hedge explained.

In the Armour study, scientists are using the uniflow type vortex tube—a cylindrical pipe which creates a whirlpool, or vortex, when air enters the tube at an angle to the opening.

The vortex creates a cold air region in the center of the tube which compensates for the aerodynamic heating effect produced by high speeds.

As a reult, a vortex thermometer has been developed that measures true air temperature independently of aircraft velocity and with little effect upon performance at altitudes up to 40,000 feet.

This thermometer will measure true air temperature for aircraft traveling up to 700 miles an hour—approximately the speed of sound—and shows possibilities of indicating true air temperature at velocities exceeding the speed of sound.

NU Professor Gets Defense Post

A Northwestern University professor has received a presidential appointment as consultant to the secretary of defense.

He is Clarence E. Watson, chairman of the department of industrial relations in Northwestern's technological institute.

Watson will assist the department during the summer in adopting recommendations of the Hoover Commission Report and in formulating policy toward American GI's who defected to communism while prisoners of war and who now seek repatriation.

He reported in Washington on July 18 to take the oath of office and will return to Northwestern in the fall.

Watson now serves as consultant to the Standard Oil Company, Chicago, and has been consultant in engineering personnel problems to the General Electric Company, Schenectady, N. Y. He joined Northwestern's faculty in 1941 and during World War II was director of the Navy V-12 program on the campus.

Educated at the University of Cincinnati, Watson had extensive experience in business and industry before coming to Northwestern. He is editor of the *Journal of Engineering Education* and assistant secretary of the American Society for Engineering Education.

Chicago Firm Forms Venezuelan Affiliate

Vern E. Alden Company, Engineers, 33 North La Salle Street, has formed a new corporation in Venezuela for the purpose of doing engineering and construction work in South America. The name of the new company is Vern E. Alden Engineering and Construction Company of Venezuela, C.A. (Alden Company of Venezuela is the abbreviation), and it will have headquarters in Caracas.

Alden, MWSE, senior partner of the Chicago firm and president of the new company, has returned from Caracas where he successfully negotiated two contracts with the Texas Petroleum Company to take over their activities relating to building and maintenance of roads and well locations and other earth-moving work. The new company also plans to do engineering and construction in a wide variety of industrial fields.

F. Ivar Wennerholm, MWSE, senior partner and construction manager of the Chicago firm and vice-president of the new company, is currently in Venezuela getting the work for Texas Petroleum under way. G. W. Young, general manager, and A. H. Chamberlain, superintendent, respectively, of the new company, accompanied Wennerholm to Venezuela where the latter two will make their permanent residence.